PATENT SPECIFICATION (11) 1 596 409

1 596 409

(21) Application No. 18514/80 (22) Filed 6 Dec 1977

(62) Divided out of No. 1 596 408

(31) Convention Application No. 2655583 (32) Filed 8 Dec 1976 in

(33) Fed Rep of Germany (DE)

(44) Complete Specification Published 26 Aug 1981

(51) INT. CL.[3] B27B 19/02 B23D 51/16

(52) Index at Acceptance B5L 104 DS

(54) JIG SAW

(71) We, BLACK AND DECKER INC., a corporation organized and existing under the laws of the State of Delaware, United States of America, whose address is Drummond Plaza Office Park, 1423 Kirkwood Highway, Newark, Delaware 19711 United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a jig saw.

It has been long known that it is advantageous if the saw blade or saw-blade holder is caused to traverse a closed path such as an elliptical path. This has been achieved by imparting to the saw blade or saw-balde holder a reciprocating movement in a direction transverse to the up and down reciprocating movement of the saw-blade holder.

The present invention provides a power operated jig saw including a saw blade holder, and drive means operable, when a saw blade is held by the saw blade holder, to reciprocate the saw blade holder along the longitudinal axis of the saw blade, the drive means including a can surface which is operatively connectible to the saw blade holder to impart thereto a reciprocating movement transverse to the direction of said longitudinal axis of the saw blade, the cam surface being so shaped that, when the saw blade holder is operatively connected thereto, a saw blade attached to the holder will trace out a closed loop path in which a major portion of a longitudinal stroke of the saw blade is accompanied by transverse movement in one direction only.

In one embodiment, the can surface is so shaped that forward and return longitudinal strokes of the saw blade are each accompanied, over a major portion thereof, by transverse movement in a single respective direction only.

In another embodiment, the can surface is so shaped that longitudinal strokes of the saw blade in only one direction are each accompanied, over a major portion thereof, by the transverse movement; the cam surface being so shaped that major portions of the longitudinal strokes in the opposite direction are accompanied by no transverse movement.

Preferably, the drive means includes a rotatably-mounted member, and the cam surface is concentric with the axis of rotation of said member.

By way of example, an illustrative embodiment of the invention will now be described with reference to the accompanying drawings, of which:

Figure 1 is a schematic diagram showing an elevation view, partially in section, of a jig saw;

Figure 2 is a section view taken along line II-II of Figure 1 and shows the balancing weight guided in the housing of the tool;

Figure 3 is a section view taken along line III-III of Figure 1 and shows the eccentric pin for actuating the elongated saw-blade holder in the up and down direction as well as the continuous cam surface for acting upon the carrier;

Figure 4 is a section view taken along line IV-IV of Figure 1 and shows the saw-blade holder and the eccentric pin engaging a longitudinal slot formed in the saw-blade holder;

Figure 5 shows several enclosed paths which a saw-blade can trace depending upon the contours of the cam surface; and,

Figure 6 is an expanded elevation view of the cam surfaces required to generate corresponding ones of the paths shown in Figure 5.

The jig saw illustrated in Figure 1 includes a motor housing 1 containing a motor 2 which constitutes part of the drive means. A gear case 3 is second to the housing 1. The free end of the armature shaft 5 of the drive motor 2 extends into the gear case 3 and is journalled in a bearing 6. The gear case 3 is provided with a gear-case cover 4 and at the lower end of the gear case, there is secured a shoe 7 having a bifurcated front end so that the saw blade 8 can pass therethrough.

A shaft 9 is arranged parallel to the armature shaft 5 within the gear-case housing 3 and carries the inner race of a bearing 10. The shaft 9 is held in place with the aid of a disc 11 which is secured to the end of the shaft with the aid of a threaded member 12. The outer race of the bearing 10 is mounted in a bushing 13 defining a continuous surface upon which a gear 14 is press-fitted. The gear 14 engages with the pinion 15 so that when the armature shaft 5 rotates, the bushing 13 will rotate about the longitudinal axis of the shaft 9.

Screws 16 secure a cam disc 17 to the bush-

ing 13. The cam disc 17 has a centroidal axis coaxial with the longitudinal axis fo the shaft 9. An eccentric pin 18 is mounted on the cam disc 17 and is radially spaced from the centroidal axis of cam disc 17 and carries a bearing 19 at its free end. This bearing 19 extends into an elongated opening 20 (Figure 4) formed in the elongated saw-blade holder 21. The opening 20 extends perpendicular to the longitudinal axis of the saw-blade holder 21. With this arrangement, a rotation of the cam disc 17 about its centroidal axis produces an eccentric rotational movement of the pin 18 to reciprocate the saw-blade holder 21 in the direction of its longitudinal axis.

The elongated saw-blade holder 21 is held by an upper bearing 22 and a lower bearing 23. These bearings are self-aligning bearings in that they are free to rotate within a limited range. The upper bearing 22 is connected to the gear-case cover 4 with the aid of a cross member; whereas, the lower bearing 23 is mounted in a carrier 24 whose function will be described below. At the lower end of the saw-blade holder 21 which extends out beyond bearing 23, a clamp 25 is provided for mounting a saw-blade 8.

The cam disc 17 is caused to rotate about its centroidal axis when the armature shaft 5 drives the gear 14. At the same time, the eccentric pin 18 moves through a circle and actuates the saw-blade holder 21 through an upward and downward movement. A balancing weight 26 is arranged on the bushing 13 for reducing to a minimum both vibration and loads on the bearings caused by imbalances (Figure 2).

The cam disc 17 includes a cam surface means in the form of a cam surface 27 having an annular configuration and extending about the periphery of the cam disc as shown in Figure 3. The cam surface 27 lies approximately in a plane which extends at an incline with respect to the centroidal axis of the cam disc 17. The cam surface 27 is shown engaging a roller bearing 28 of the carrier 24, the roller serving to minimize friction between the cam surface and the carrier. The carrier 24 holds the lower bearing 23 and is resiliently biased by means of a leaf spring 29 which urges the carrier 24 toward the right.

Accordingly, when the cam disc 17 is rotated about its centroidal axis, the working surface of cam 27 engages the carrier 24. The working surface of cam 27 is contoured to have pre-determined elevations about its annular length. More specifically, the portion of the cam surface lying at the upper portion of the cam disc for the rotational position thereof as viewed in Figure 1 is further to the right as the portion of the cam surface 27 lying in the lower portion of the cam disc. Since the spring 29 is placed so that it urges the carrier 24 toward the right, a rotation of the cam disc 17 through 180° with respect to the position shown causes the carrier 24 to move to the right under the action of spring 18; and, during a further rotation of 180°, the cam disc 17 will cause the carrier 24 to return to the position shown in Figure 1. In this way, the carrier 24 is caused to reciprocate in a direction transverse to the longitudinal dimension of the saw-blade holder 21. This transverse movement is superimposed on the up and down movement so that a saw-blade 8 attached to the saw-blade holder 21 undergoes a pendular movement and traces an enclosed path.

The carrier 24 and resilient means in the form of spring 29 are exemplary of translation means for translating the rotational movement of the cam surface means 27 into a reciprocating movement of the saw-blade holder 21 in a direction transverse to the vertical direction in which the saw-blade holder 21 is reciprocated by pin 18.

The cam disc 17 rotatably mounted in the housing 3 and the cam surface means 27 together with the translation means can be viewed as conjointly consituting non-eccentric cam means. The cam surface 27 rotates symmetrically about the centroidal axis of the cam disc 17.

A shaft 30 extends in a direction perpendicular to the plane of the Figure 1 and is equipped with a cam 31 inside the housing 3. The shaft 30 is rotatable from outside of the housing 3 to thereby rotate the cam 31. In Figure 1, the cam 31 is shown in a position with its highest elevation directed upwardly from the axis of the shaft 30. When the shaft 30 is rotated, the surface of cam 31 is moved into the path of the carrier 24 and limits its horizontal movement. One of the end positions of the horizontal movement of the carrier is changed. The carrier 24 reciprocates in the horizontal direction and can be limited in its movement toward the right by cam 31 which defines end positions extending from the one illustrated wherein the carrier 24 can move so far to the right that the bearing 28 of the carrier 24 is caused to be in engagement with the cam surface 27 throughout the entire rotation of the cam disc 17 and, a second end position wherein the cam 31 engages the carrier 24 so that it is held out of contact with the cam surface 27 entirely. In this last-mentioned position, the saw-blade holder is not actuated at all in the transverse direction; whereas, in the first mentioned end position, the carrier moves through its maximum stroke. Between these two end positions, any desired end position can be set thereby maintaining a desired stroke for the transverse reciprocating movement.

The contour of the path of the saw blade is shaped by configuring the cam surface 27 of the cam disc 17 in an appropriate manner, as described below. The form of the cam surface 27 is completely independent of the position of the balancing weight 26.

The pendular movement of the saw blade when viewed from a point on the saw-blade

traces a closed path. For most effective operation, a transverse reciprocating movement should take place for a major portion of the upward movement of the saw-blade holder 21 in order to support the saw-blade as it cuts into the workpiece during the upward cutting stroke. Preferably, at the end or just before the end of the upward movement of the saw blade, the saw-blade should be moved out of engagement with the workpiece by a movement in a direction opposite to the feeding direction, and then, during the downward movement the saw-blade holder 21, the blade 8 should be moved again into the starting position for the upward cutting stroke.

Several pendular paths which can be traced by a saw-blade held in a jig saw embodying invention are shown in Figure 5 and are designated by I, II and III. These paths are generated with cam discs having respective cam surfaces 27 corresponding to the expanded plan views shown in Figure 6 and designated by corresponding reference numerals I, II and III, respectively. Figure 5 also shows a plan view of the cam surface 27 marked off in twelve 30° arcuate segments having numbered starting and end points. Points on the respective enclosed paths of Figure 5 are correspondingly numbered. In addition the position of the eccentric pin 18 is also shown.

The pendular paths of Figure 5 traced by various cam surfaces 27 shown in Figure 6 are obtained by viewing a location on the saw blade as the saw-blade moves through its composite movement wherein full reciprocation takes place in the direction transverse to the longitudinal dimension of the saw-blade holder 21. For example, the path I of Figure 5 is obtained by utilizing a cam disc having a cam surface with the contour designated by numeral I in Figure 6. The direction of movement of the observed location on the saw-blade through its working stroke and return stroke are indicated by arrows in Figure 5.

Reference in now made to path I traced by an observed point location on the saw-blade as it moves through its pendular movement. Starting at the uppermost point 12/0, the observed point location moves down an inclined segment to point 1. The movement through this segment corresponds to a rotation of the cam 27 through 30°. Thereafter, the observed point of the saw-blade moves downwardly in a vertical direction and reaches point 6 after a rotation of the cam 27 of 180° from the starting point 12/0. At point 6, the saw-blade is at the end of the downward stroke. Thereafter, the upward stroke of the saw-blade holder 21 and therewith the saw-blade 8 produces an inclined movement of the saw-blade from point 6 to point 11 during which time the saw-blade engages the workpiece. This engagement is reinforced throughout the upward movement from point 6 to point 11 so that a cutting action is produced which continues up to point 11 or just 30° before reaching the starting position 12/0 of the cam 27. When the point 11 is reached, the observed point location on the saw-blade moves diagonally to point 12/0 thereby withdrawing the saw blade from cutting engagement with the workpiece. When point 12/0 is reached, a complete rotation of the cam 27 has been completed.

As the path I in Figure 5 shows, the resulting pendular stroke is between points 1 and 11 and the effective support of the cutting operation results between point 6 and 11.

A specially contoured cam surface achieves the pendular movement described by path I. The expanded linear view designated by numeral I in Figure 6 shows the elevation and slope which the cam surface 27 must have at and between the particular points 12/0, and 1 to 11 for acting on the carrier 24 to obtain the enclosed path I of Figure 5. Referring to Figure 5, the points on the enclosed curve correspond to the radial locations on the cam surface 27 shown in the right-hand portion of Figure 5.

In Figure 6, the transverse movement for path I of Figure 5 during the work stroke between points 6 and 11 is produced by the inclined region 32 of the cam surface 27 also designated by numeral I in Figure 6. At the left end of the inclined region 32 at point 11, there is another inclined portion 33. However, portion 33 is inclined at a slope opposite to portion 32. This portion 33 extends from point 11 through point 12/0 to point 1 and causes a movement of the saw-blade in the direction opposite to that for the portion 32 so that the flat portion 33 moves the saw-blade away from the workpiece as is shown in Figure 5 for path I going from point 11 through point 12/0 to point 1.

The portion 33 runs into a flat portion 34 having zero slope which is connected to inclined portion 32 at point 6. This portion 34 of the cam surface 27 lies in a plane extending perpendicular to the centroidal axis of the cam disc 17 and defines the furtherest distance to the right which the carrier 24 can travel in the course of its reciprocating movement. When portion 34 acts upon the saw-blade, there is no transverse movement of the carrier 24 and hence of the saw-blade 8; instead the saw-blade 8 moves from point 1 without transverse movement perpendicular downwardly to point 6 and then, the inclined portion 32 moves the carrier 24 to the left as seen in Figure 1 and the saw-blade 8 is urged into cutting engagement with the workpiece as already described.

For path II in Figures 5 and 6, the cam portions 40, 41 and 42 of the cam surface 27 are 30° displaced with respect to corresponding surfaces for path I. The pendular movement resulting from path II is shown in Figure 5 under numeral II and distinguishes from the pendular movement of path I likewise by a 30° displacement which produces the result

that the movement of the saw-blade away from the workpiece which occurs for path I between point 11 and 1 over a rotational movement of 60° of the cam surface 27 begins with path II only at point 12/0 and then extends also over 60° to point 2.

The example represented by III is achieved with cam surface 27 contoured to have inclined portions 50 and 51 as shown in Figure 6. This type of contour of the cam surface with only two inclined portions produces the movement of the saw-blade 8 as shown in Figure 5. For this movement, there is no location wherein the cam surface extends in a direction perpendicular to the centroidal axis of the cam disc 17; that is, there is no portion of the cam surface that has zero slope and the saw-blade moves either into the workpiece or away from the workpiece between turning points. More particularly, for path III, from point 6 to point 11, the saw-blade 8 moves into the workpiece and, between points 11 and 12/0 and between 12/0 and point 6, the saw blade moves away from the workpiece.

The foregoing shows that the cam surface can be contoured over its arcuate length to have a predetermined elevation in the direction of the stroke of the carrier 24 to thereby reciprocate the carrier 24 through its stroke length in response to the rotation of the cam disc 17 about its rotational axis. The slope of the cam surface 27 is selected to cause the carrier 24 to be reciprocated in such a manner that the top of the blade 8 connected to the saw-blade holder 21 traces out an enclosed path of predetermined shape.

The contour of path I provides especially good cutting characteristics since the saw blade is moved into the workpiece for almost the entire unward stroke from point 6 up to point 11. At point 11 the saw blade moves through point 12/0 to point 1 thereby withdrawing the blade from cutting engagement and providing ample space to clear the chips before the blade moves downwardly to point 6.

Referring again to Figure 1, it is noted that the entire operating mechanism of the jig saw is contained in the housing 3 and cover 4. The fact that the lower bearing 23 is enclosed as shown insures that it remains lubricated for a much greater time than it would be if it were exposed like the rollers of the prior art jig saws already discussed.

The bearings 22 and 23 are sleeve bearings and hold respective portions of the saw-blade holder 21. The bearings 22 and 23 are of substantially cylindrical configuration and are arranged in the carrier and housing, respectively, so as to have their respective longitudinal axes extend thransverse to the longitudinal axis of the saw-blade holder 21. The bearings are seated to permit rotation only about their respective longitudinal axes and each of the bearings has a rectangular slot for slideably accommodating the saw-blade holder 21 therein whereby the saw-blade holder is firmly held in the hearings to minimize bending about the longitudinal axis of the saw-blade holder. Also, the wide bearing surface within the bearings proper causes the saw-blade holder 21 to be subjected to a distributed load rather than a point load as is the case, for example, in those jig saws of the prior art wherein a roller supports the saw-blade on its back end-face.

In the jig saw described above the pendular movement of the saw-blade is achieved by a direct coupling to the drive means which does not require an additional eccentric. Also, the transverse motion in feed direction is applied to the saw-blade holder at a location spaced away from the saw-blade where it cannot be contaminated by the chips cut by the saw-blade.

The jig saw requires no specially configured saw blades to achieve pendular motion.

The shape of the enclosed path traced by the saw-blade during pendular motion is independent of the position of the saw-blade holder. Also, the enclosed path traced by the saw-blade can be made to have a pre-determined shape.

A power-operated jig saw as described above is also described in our co-pending Application No. 50727/77 Serial No. 1 596 408 which claims a power operated jig saw comprising a saw blade holder, and drive means operable, when a saw blade is held by the saw blade holder, to reciprocate the saw blade holder along the longitudinal axis of the saw blade, the drive means including a rotatably-mounted member and a cam surface which is concentric with the axis of rotation of said member and which is operatively connectible to the saw blade holder to impart thereto a reciprocatin movement transverse to the direction of said longitudinal axis of the saw blade.

WHAT WE CLAIM IS:—

1. A power operated jig saw including a saw blade holder, and drive means operable, when a saw blade is held by the saw blade holder, to reciprocate the saw blade holder along the longitudinal axis of the saw blade, the drive means including a cam surface which is operatively connectible to the saw blade holder to impart thereto a reciprocating movement transverse to the direction of said longitudinal axis of the saw blade, the cam surface being so shaped that, when the saw blade holder is operatively connected thereto, a saw-blade attached to the holder will trace out a closed loop path in which a major portion of a longitudinal stroke of the saw blade is accompanied by transverse movement in one direction only.

2. The power operated jig saw of Claim 1, in which the cam surface is so shaped that forward and return longitudinal strokes of the saw blade are each accompanied, over a major portion thereof, by transverse movement in a single respective direction only.

3. The power operated jig saw of Claim 1, in

which the cam surface is so shaped that longitudinal strokes of the saw blade in only one direction are each accompanied, over a major portion thereof, by the transverse movement; the cam surface being so shaped that major portions of the longitudinal strokes in the opposite direction are accompanied by no transverse movement.

4. The power operated jig saw of any one of the preceding claims, in which the drive means includes a rotatably-mounted member, and the cam surface is concentric with the axis of rotation of said member.

5. The power operated jig saw of Claim 4, in which the cam surface is formed on said rotatably-mounted member for rotation therewith; and in which the drive means includes translation means for translating the rotational movement of said cam surface means into the reciprocating movement of said saw-blade holder in a direction transverse to the direction of said longitudinal axis.

6. The power operated jig saw of Claim 5, including a counterbalancing weight slideably arranged in a housing of the jig-saw, and eccentric means formed on said rotatably-mounted member and said weight for receiprocating said weight in said housing.

7. The power operated jig saw of Claim 5 or Claim 6, in which said translation means includes,

a carrier slideably holding said saw-blade holder and mounted so as to be reciprocally movable over a predetermined stroke length in the said transverse direction; and,

resilient means for urging said carrier into engagement with said cam surface means whereby said carrier rides on said cam surface and reciprocally moves through said predetermined stroke length in response to the rotational movement of said cam surface.

8. The power operated jig saw of Claim 7, in which said bearing means comprises

a first pivot bearing for slideably holding said saw-blade holder at one portion thereof; and,

a second pivot bearing mounted on said carrier for slideably holding said saw-blade holder at another portion thereof.

9. The power operated jig saw of Claim 8, in which said portions of said saw-blade holder are of rectangular cross-section and wherein said bearings are of substantially cylindrical configuration and arranged so as to have their resepective longitudinal axes extend transverse to said longitudinal axis of said saw-blade holder, said bearings being seated so as to permit rotation only about their respective longitudinal axes, each of said bearings having a rectangular slot for slideably accommodating said saw-blade holder therein whereby said saw-blade holder is firmly held in said bearings to minimize bending about said longitudinal axis of said saw-blade holder.

10. The power operated jig saw of any of Claims 5 to 9, in which said cam surface comprises an annular face cam concentric with said rotation axis.

11. The power operated jig saw of Claim 7 and Claim 10, in which said rotatably-mounted member is mounted with said rotation axis being substantially parallel to the stroke of said carrier, said cam surface being contoured at each point along its arcuate length to have a predetermined elevation in the direction of said stroke of said carrier thereby to reciprocate said carrier through said stroke length in response to the rotation of said rotatably-mounted member about said rotational axis thereof, the slope of said cam surface being selected to cause said carrier to be reciprocated in such a manner that the tip of a blade connected to said saw-blade holder traces out an enclosed path of predetermined shape as said saw-blade holder is reciprocated in said direction of said longitudinal axis by said drive means.

12. The power operated jig saw of Claim 7 and either Claim 10 or 11, including roller means at the interface of said carrier and said annular cam surface for minimizing friction there-between.

13. The power operated jig saw of any preceding claim, including means for adjusting the extent of the reciprocating movement of the saw blade holder in the direction transverse to the direction of the longitudinal axis of the saw blade holder.

14. The power operated jig saw of Claim 13 when dependent upon Claim 7, in which said adjusting means comprising: a cam eccentrically-mounted so as to be rotatable into the path of said carrier so as to vary the magnitude of said stroke length through a range extending from said predetermined stroke length to zero stroke length.

15. The power operated jig saw of any preceding claim, in which said drive means includes eccentric means formed on said cam surface and engaging said saw-blade holder for reciprocating said saw-blade holder in the direction of said longitudinal axis.

ABEL & IMRAY
Chartered Patent Agents
Northumberland House
303-306 High Holborn
London WC1V 7LH

Printed for Her Majesty's Stationery Office by MULTIPLEX medway ltd., Maidstone, Kent, ME14 1JS. 1981. Published at the Patent Office, 25 Southampton Buildings, London WC2 1AY, from which copies may be obtained.

1596409 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

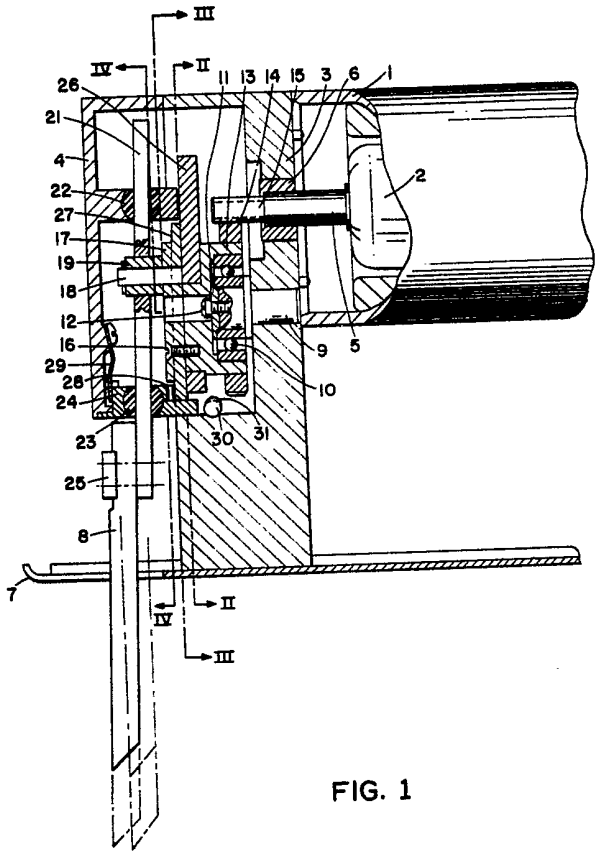

FIG. 1

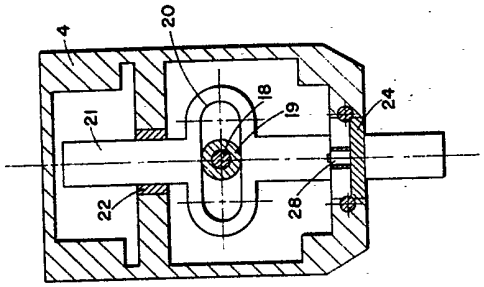

FIG. 4

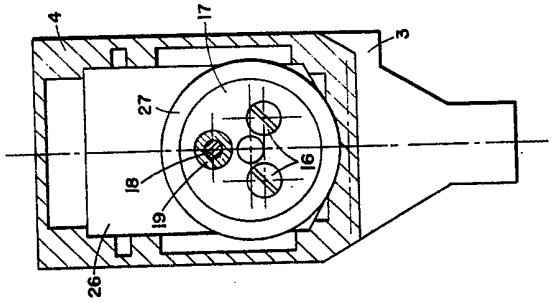

FIG. 3

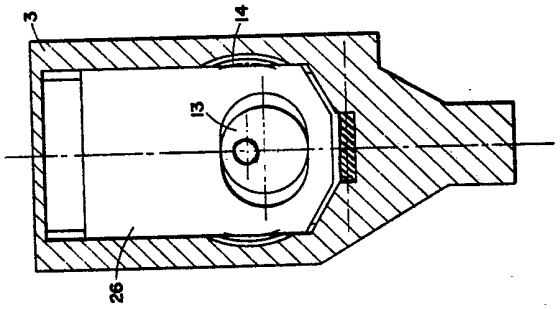

FIG. 2

1596409 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

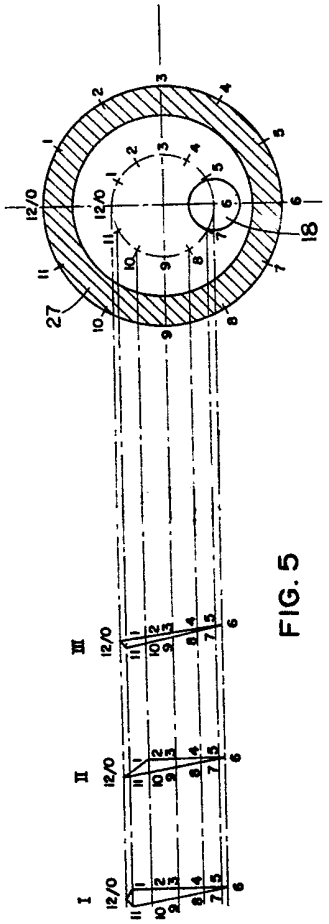

FIG. 5

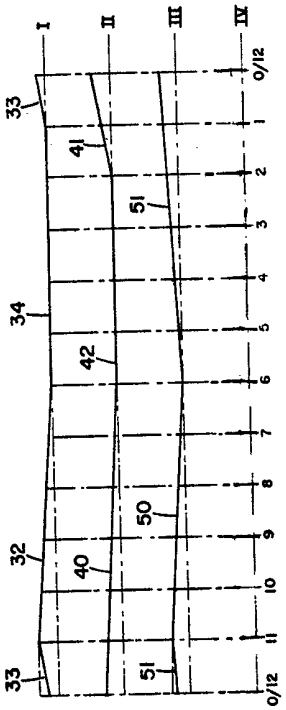

FIG. 6